

NEW INFORMATION ON THE ICHTHYOFAUNA OF THE SOUTH-EASTERN ITALIAN COASTS (IONIAN SEA)

by

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ABSTRACT. - A list of fish (selachians and teleosts) collected in the north-western Ionian Sea during bottom trawl surveys carried out from 1985 to 1993 is reported. A total of 159 species were identified (19 selachians, 140 teleosts) on the fishing grounds. The species *Raja rondeleti*, *Nemichthys scolopaceus* and *Bathophilus nigerrimus* have been found for the first time in the Ionian Sea. The majority of the species have an Atlanto-Mediterranean diffusion. *Galeus melastomus* and *Merluccius merluccius* were the most common and abundant selachian and teleost respectively in the investigated area. A wider depth distribution than that known in the literature was observed for some species. A high affinity between the demersal fish fauna of the north-western Ionian and southern Adriatic is shown. A scheme of frequency and abundance for the ichthyofauna collected during the research period has been provided.

RÉSUMÉ. - Les auteurs présentent une liste des espèces de sélaciens et de téléostéens échantillonnées dans le secteur nord-ouest de la Mer Ionienne au cours de chalutages effectués sur le fond, de 1985 à 1993. Au total, 159 espèces (19 sélaciens et 140 téléostéens) ont été identifiées, dont 3 qui n'avaient jamais été signalées en Mer Ionienne: *Raja rondeleti*, *Nemichthys scolopaceus* et *Bathophilus nigerrimus*. La plupart des espèces recensées ont une diffusion atlanto-méditerranéenne. Les espèces les plus communes sont *Galeus melastomus* et *Merluccius merluccius* tandis qu'on a pu relever, pour beaucoup d'espèces collectées, une distribution bathymétrique plus grande que celle qui est citée dans la littérature. Une affinité significative a été montrée entre la faune ichtyologique du nord-ouest de la mer Ionienne et celle du sud de la mer Adriatique. Enfin, la fréquence et l'abondance pour chaque espèce pêchée durant cette période sont présentées dans un tableau.

Key-words. - Ichthyofauna, MED, Ionian Sea, Demersal fisheries, New records.

The most recent lists regarding the fish species living in the Ionian Sea of the south-eastern Italian coasts are by Pastore (1976) and Parenzan (1983). The former, revising the collection of the Talassographic Institute of Taranto, considering records from the past (Targioni-Tozzetti, 1871; Parenzan, 1957, 1960; Gallotti, 1973) and his own samplings carried out in the area, reported a total of 257 species: 32 selachians and 225 teleosts. Among the second group the author did not consider the species of the families Scomberomoridae and Thunnidae (actually Scombridae) although present in the area. The list by Parenzan (op. cit.) concerned the Apulian Sea (Ionian and southern Adriatic Sea) and included 275 fish species: 50 selachians and 225 teleosts not all corresponding to those considered by Pastore (op. cit.). In fact, apart from some species found only in the southern Adriatic Sea, Parenzan (op. cit.) reported some new species in the Ionian Sea but did not consider many of the ones listed by Pastore (op. cit.).

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Besides the two lists mentioned above, a new contribution to the knowledge of the fish fauna of the Ionian Sea is provided by the research on demersal resources, carried out through seasonal trawl surveys (Tursi *et al.*, 1988; D'Onghia *et al.*, 1989; Tursi *et al.*, 1992b, 1993a). These surveys, in addition to monitoring the distribution and population structure of the various species as far as 700 m in depth, have the peculiarity of exploring new areas and contributing to new specific records (Tursi *et al.*, 1992a). However, the trawl net only allows sampling of species that have a relation with the bottom and can only occasionally catch pelagic species.

This paper includes the list of the fish species (selachians and teleosts) found in the north-western Ionian Sea during trawl surveys carried out from 1985 to 1993. Moreover, information concerning their bathymetric distribution is reported as well as data on frequency and abundance in the study area.

MATERIALS AND METHODS

The marine area under study covers a surface of about 11,000 km² between the Cape of Otranto and Cape Spartivento, and ranges from depths of 10 m to depths of 700 m (Fig. 1).

In this area, the Institute of Zoology and Comparative Anatomy of the University of Bari has carried out, since 1985, several seasonal trawl surveys in the context of national and international research projects. Data reported in this paper are related to thirteen of them.

A professional trawler provided with standard equipment was chartered. In particular, a nylon otter trawl net was used, with stretched mesh of 40 mm in the codend. The horizontal and vertical net opening, measured by means of SCANMAR sonar system and depending on various factors (depth, warps length, towing speed, etc.), ranged from 12.46 to 23.89 m and from 0.91 m to 0.95 m respectively (Fiorentini *et al.*, 1993). The vessel speed, measured by using GPS, was maintained at 2.5-3.0 knots. An average number of 30 fishing stations were randomly selected for each trawl survey. The number of the stations, at each depth, was proportional to the extension of the surface of the following bathymetric strata: 10-50 m (5 hauls); 50-100 m (3 hauls); 100-200 m (5 hauls); 200-450 m (8 hauls); 450-700 m (9 hauls).

The fish collected, together with other fauna, were preliminarily determined on board and then brought to the laboratory for further analysis.

Determination of the fish species was made using systematic keys as reported by Tortonese (1956, 1970, 1975), Compagno (1984), Whitehead *et al.* (1984-1986) and Bauchot (1987). The nomenclature and the systematic order of the species is reported as proposed by Hureau and Monod (1978).

A frequency index and a category of abundance have been assigned to the species as by Dajoz (1971). In particular, the frequency index has been estimated as percentage ratio between the number of hauls in which the species was found and the total number of hauls ($if = n_i/N_T$). Concerning abundance, related to the number of individuals found per unit of surface (N/km^2), five categories have been considered: from very rare to very abundant. In particular, considering the wide range of values estimated, the logarithm of the abundance $[(\log N/\text{km}^2 + 1)]$ is ranked as follows: 1 - very rare: < 0.3 ; 2 - rare: from 0.3 to 1.00; 3 - not rare: from 1.00 to 2.00; 4 - abundant: from 2.00 to 3.00; 5 - very abundant: > 3.00 .

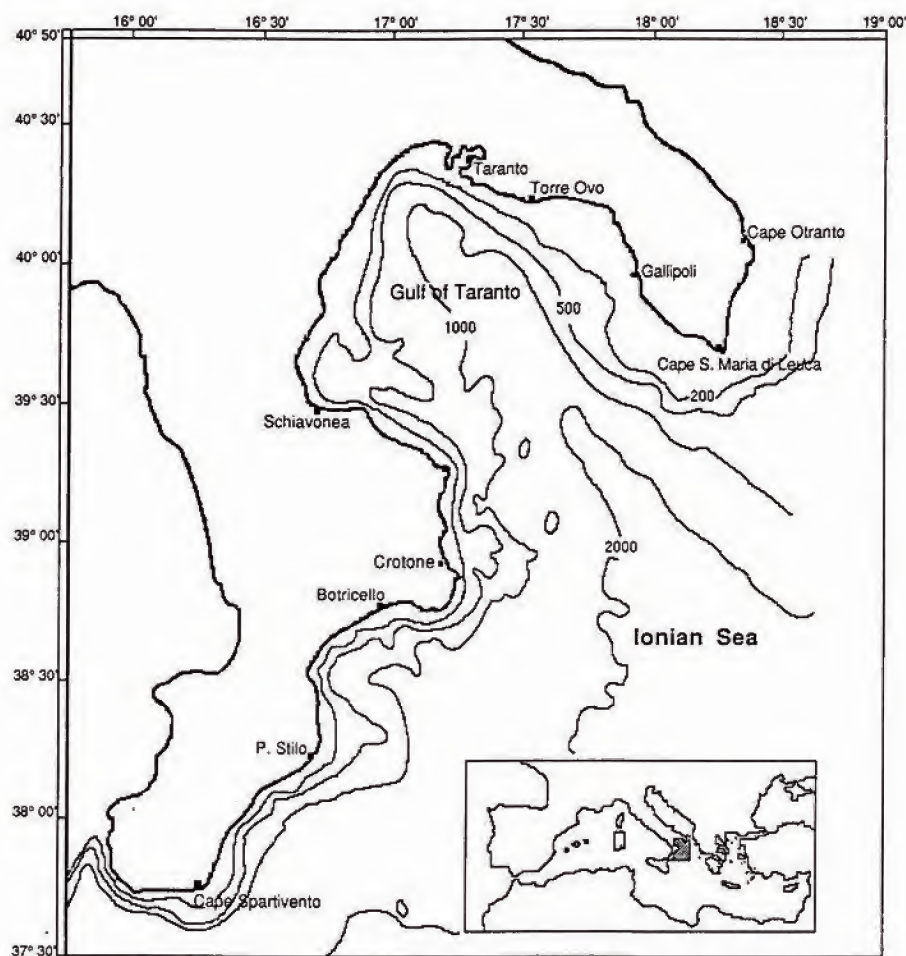


Fig. 1. - Map of the area investigated in the Ionian Sea.

The surface swept by the gear during a tow was calculated as proposed by Pauly (1983).

The employment of the frequency index and abundance category come from the fact that very different situations can be found for the various species. For example, a certain fish species may be caught many times (high frequency index) but with one or few specimens (very rare or rare) or it may be found very few times (low frequency index) but with a large number of specimens (not rare or abundant). While the frequency was estimated for thirteen surveys (386 hauls) the abundance of the species has been computed for the last four surveys (120 hauls).

However, both the estimates depend on the frequency and abundance of the species in the study area relative to the trawl net used.

RESULTS

A total of 159 fish species, 19 selachians and 140 teleosts, were found in the study area during the research carried out until 1993. A systematic list of these species is presented in tables I and II, together with synthetic information on their bathymetric distribution, frequency and abundance (since many species were not found in the last four surveys, the abundance categories are lacking for them in the tables).

Selachians

The selachians caught, belong to 8 families and 11 species of them are marketable for human consumption; 4 species were only found during spring and 3 exclusively in autumn.

The species *Raja circularis*, *R. fullonica* and *R. rondeleti* were not reported by Pastore (1976) and Parenzan (1983). Whitehead *et al.* (1984) and Bauchot (1987) considered the Ionian Sea as being within the geographic distribution of the first two species while the presence of *R. rondeleti* in the area is not indicated in the geographic map reported by these two last authors. *R. rondeleti* is considered a benthic species rarely found in the Mediterranean (Hureau and Monod, 1978; Whitehead *et al.*, 1984-86). So that, the exceptional capture of 57 young specimens, at 50 m of depth in the Gulf of Taranto, during April 1986, is the first finding of the species in the Ionian Sea.

Generally, batoids were found few times and with one or two specimens. Many species were not fished at all during the last four surveys. Also some sharks, such as *Squalus acanthias* and *Centrophorus granulosus*, were rarely caught.

The most common and abundant selachian in the study area was *Galeus melastomus* the vertical distribution of which regarded depths greater than 200 m and only exceptionally shallower waters.

The species *Etmopterus spinax* and *Chimaera monstrosa* were found to be not rare in the area. However, they were collected only during the trawls carried out on bathyal grounds in both seasons, exhibiting a frequency index of 11.92% and 6.99% respectively.

Scyliorhinus canicula was fished with similar frequency and abundance as these latter species. It showed a wider distribution in spring than in autumn.

Teleosts

The species of teleosts collected on the trawlable bottoms of the study area belong to 59 families and 15 orders. Over 50% of the species are of economic interest, obviously with a different market value for each one. A total of 19 species were only fished during spring surveys while 14 exclusively during autumn.

The species *Nemichthys scolopaceus*, *Bathophilus nigerrimus*, *Scorpaena elongata* and *S. loppei* have been found for the first time in the north-western Ionian Sea.

Nemichthys scolopaceus was not mentioned in the previous lists (Pastore, 1976; Parenzan, 1983) and its geographic distribution was not considered to extend to the Ionian Sea by Whitehead *et al.* (1984-86). The specimen found in the Ionian Sea was a male, 1017 mm in length, which was caught at a depth of 528 m off the coast of Torre Ovo (Apulia) during March 1994. The colour of this species is described in very different ways by various authors (Tortonese, 1970; Torchio *et al.*, 1984) but for this specimen it corresponded to that reported by Dieuzeide (in Tortonese, 1970), namely the specimen was brownish with grey-greenish reflections and with a fine dotting which covered the

whole body and was particularly intense on the head. This species is considered a stenothermic, euribathyc form whose adults are generally caught with one or two individuals at time (Torchio *et al.*, 1984). The species is considered present in all oceans (Hureau and Monod, 1978).

An unsexed specimen 100 mm in length of *Bathophilus nigerrimus* was found off the coast of Crotone (Calabria) at 350 m of depth during September 1985. The rare mediterranean records of this species are within 400 m of depth (Raimbault, 1963; Tortonese, 1970). The species was also found stranded by Berdar (1970) in the Strait of Messina. An Atlanto-Mediterranean distribution is recognized for this fish (Hureau and Monod, 1978).

The presence of *Scorpaena elongata* and *S. loppei* in the Ionian Sea is related to the eastern side (Tortonese, 1975; Kaspiris, 1976; Economidis and Daulas, 1979, 1981; Bauchot, 1987). Both species were reported in list of Parenzan (1983) but the author referred to records in the southern Adriatic Sea. *S. elongata* was found in the study area during two different hauls: an immature female was caught off the coast of Santa Maria di Leuca (Apulia) at 275 m in depth during May 1992 and an unsexed specimen was found along the Calabrian coast at 175 m during the month of November of the same year. *S. loppei* was found off the coast of Botricello (Calabria) at 30 m during May 1992. It was an immature specimen. This species is the smallest of the genus living in the Mediterranean Sea.

Glossanodon leioglossus, *Gadiculus argenteus argenteus*, *Nezumia sclerorhynchus*, *Epinephelus aeneus*, *Callionymus pusillus*, *Arnoglossus rueppelli*, *Lepidorhombus boscii*, *L. whiffiagonis* were not reported in the previous lists by Pastore (op. cit.) but were considered present in the area by Whitehead *et al.* (1984-86) and Bauchot (1987).

The species *Epigonus denticulatus* was not reported by Whitehead *et al.* (1984-86); Bauchot (1987) indicated its occurrence only on the southern Calabrian coasts. In fact, the only previous record of the species in the north-western Ionian was reported near the Strait of Messina (Sicily) (Gramitto and Frogliia, 1983). *E. denticulatus* was fished exclusively on bathyal ground sometimes with a large amount of small specimens.

Among the teleosts caught during this research, the first finding of *Sphoeroides pachygaster* has been recently recorded in the area (Tursi *et al.*, 1992a). Another specimen of this species, a female with maturing gonad, was caught during May 1992 at a depth of 400 m, off Gallipoli (Apulian coasts). This species was considered to be distributed in eastern Atlantic, Japan, Hawaii (Hureau and Monod, 1978) and recently also in Mediterranean (Oliver, 1981; Cerro and Portas, 1984; Moreno and Roca, 1984; Barletta and Torchio, 1986).

As regards the frequency and abundance of the various species, *Merluccius merluccius* was the most common and abundant fish across the whole bathymetric range investigated, both in spring and autumn. *Mullus barbatus* was ranked as very abundant but its frequency was lower than that of other less abundant species, e.g., *Conger conger*, because it was almost exclusively fished on the continental shelf while other species had a wider depth distribution.

High frequency indexes and abundance were exhibited by *Micromesistius pouasou*. Even if with different bathymetric distribution the species *Phycis blennoides*, *Helicolenus dactylopterus dactylopterus* and *Trachurus trachurus* were found to be rather frequent and abundant.

Family - Species	Bathymetric stratum (m)				Depth (m) min max	Frequency index (%)	Abundance category
	0-50	50-100	100-200	200-450	450-700		
SCYLIORHINIDAE							
* <i>Scyliorhinus canicula</i> (Linnaeus, 1758)		x	x y	x y	x	8.03	3
* <i>Galeus melastomus</i> Rafinesque, 1810		x y		x y	x y	31.61	4
CARCHARHINIDAE							
* <i>Mustelus mustelus</i> (Linnaeus, 1758)	x y	x y				1.81	1
SQUALIDAE							
* <i>Squalus acanthias</i> Linnaeus, 1758	x					0.26	-
* <i>Centrophorus granulosus</i> (Schneider, 1801)				y		0.77	1
* <i>Etmopterus spinax</i> (Linnaeus, 1758)				x y	x y	11.92	3
* <i>Scymnorchinus ticha</i> (Bonnaterre, 1788)					x y	1.81	2
TORPEDINIDAE							
* <i>Torpedo torpedo</i> (Linnaeus, 1758)	y					0.78	-
* <i>Torpedo marmorata</i> Risso, 1810	x	x y	y	x y		3.11	-
* <i>Torpedo nobiliana</i> Bonaparte, 1835				x y	y	1.30	-
RAJIDAE							
* <i>Raja miraletus</i> Linnaeus, 1758	x	x		x		0.78	1
* <i>Raja asterias</i> Delaroche, 1809				x		1.04	1
* <i>Raja batis</i> Linnaeus, 1758			y			0.26	-
* <i>Raja fullonica</i> Linnaeus, 1758			y		x	0.52	-
* <i>Raja circularis</i> Couch, 1838	x y	y	y	x	x y	2.33	1
* <i>Raja rondeleti</i> Bougis, 1959		x				0.26	-
DASYATIDAE							
* <i>Dasyatis pastinaca</i> (Linnaeus, 1758)	y					0.78	-
MYLIOBATIDAE							
* <i>Pteromyia bovinus</i> (E.G. Saint-Hilaire, 1817)	x y					1.30	-
CHIMAERIDAE							
* <i>Chimaera monstrosa</i> Linnaeus, 1758				x y	x y	6.99	3

Table I. - List of Selachians found in the study area during trawl surveys carried out from 1985 to 1993. * = marketable species; ° = new record in the north-western Ionian Sea; x = spring; y = autumn.

Table II. - List of Teleosts found in the study area during trawl surveys carried out from 1985 to 1993.

* = marketable species; ° = new record in the north-western Ionian Sea; x = spring; y = autumn.

Family - Species	Bathymetric stratum (m)					Depth (m)		F (%)	A.c.
	0-50	50-100	100-200	200-450	450-700	min	max		
CLUPEIDAE									
* <i>Sardina pilchardus</i> (Walbaum, 1792)	x y	x y	y	x y	x	16	470	7.25	2
* <i>Sprattus sprattus</i> (Linnaeus, 1758)	x					20		0.52	-
ENGRAULIDAE									
* <i>Engraulis encrasicolus</i> (Linnaeus, 1758)	x	x y	x y	y		20	210	3.11	1
GONOSTOMATIDAE									
<i>Gonostoma denudatum</i> Rafinesque, 1810					x		500	0.26	-
STERNOPTYCHIDAE									
<i>Argyroleucus hemigymnus</i> Cocco, 1829					x y		544	0.52	1
CHAULIODONTIDAE									
<i>Chauliodus sloani</i> Schneider, 1801					x	500	625	1.04	1
STOMIATIDAE									
<i>Stomias boa</i> (Risso, 1810)				y	x	300	644	1.30	2
MELANOSTOMIATIDAE									
° <i>Bathophilus nigerrimus</i> Giglioli, 1884				y			350	0.26	-
ARGENTINIDAE									
* <i>Argentina sphyraena</i> Linnaeus, 1758			x y	x y		105	425	11.40	4
* <i>Glossanodon leioglossus</i> (Valenciennes, 1848)			y	x y	x y	180	500	1.55	4
AULOPIDAE									
<i>Aulopus filamentosus</i> Cloquet, 1816				x y		275	350	0.52	1
SYNODONTIDAE									
<i>Synodus saurus</i> (Linnaeus, 1758)	x y					11	50	3.37	2
CHLOROPHTHALMIDAE									
<i>Chlorophthalmus agassizi</i> Bonaparte, 1840			x	x y	x y	175	625	14.77	4
MYCTOPHIDAE									
<i>Diaphus rafinesquei</i> (Cocco, 1838)					y		625	0.26	-
<i>Lampanyctus crocodilus</i> (Risso, 1810)				x	x y	370	690	4.40	3
PARALEPIDIDAE									
<i>Sudis hyalina</i> Rafinesque, 1810				y			300	0.26	-
NEMICHTHYIDAE									
° <i>Nemichthys scolopaceus</i> Richardson, 1848					x		528	0.26	1
NETTASTOMATIDAE									
<i>Nettastoma melanurum</i> Rafinesque, 1810				x y	x y	410	690	2.59	2
CONGRIDAE									
* <i>Conger conger</i> (Linnaeus, 1758)	x y	x y	x y	x y	x y	12	690	40.41	3
<i>Ariosoma balearicum</i> (Delaroche, 1809)				x y		250	280	0.52	-
<i>Gnathopis mystax</i> (Delaroche, 1809)				x y	x y	300	590	1.55	2
ECHELIDAE									
<i>Echelus myrus</i> (Linnaeus, 1758)	x y			y	y	40	550	1.30	1
OPHICHTHIDAE									
<i>Dalophis imberbis</i> (Delaroche, 1809)	x						30	0.26	1
NOTACANTHIDAE									
<i>Notacanthus bonapartei</i> Risso, 1840			x		x y	120	650	4.40	2
MACRORHAMPHOSIDAE									
<i>Macroramphosus scolopax</i> (Linnaeus, 1758)	x	x y	x y	x y	y	20	575	11.40	4
SYNGNATHIDAE									
<i>Syngnathus acus</i> Linnaeus, 1758	x y	y				20	70	1.04	1
MACROURIDAE									
<i>Trachyrhynchus trachyrhynchus</i> (Risso, 1810)					x y	500	700	3.11	3
<i>Hymenocephalus italicus</i> Giglioli, 1884				x	x y	250	700	10.62	4
<i>Nezumia sclerorhynchus</i> (Valenciennes, 1838)				x	x y	275	700	10.10	4
<i>Coelorhynchus coelorhynchus</i> (Risso, 1810)				x y	x y	260	690	10.62	4
MERLUCCIIDAE									
* <i>Merluccius merluccius</i> (Linnaeus, 1758)	x y	x y	x y	x y	x y	20	690	72.28	5
GADIDAE									
<i>Gadiculus argenteus argenteus</i> Guichenot, 1850		x y	x y	x y	x y	85	690	16.58	4
<i>Merlangius merlangus euxinus</i> (Nordmann, 1840)		x y			x	60	550	0.78	-
* <i>Micromesistius poutassou</i> (Risso, 1826)		x y	x y	x y	x y	100	690	48.45	5
* <i>Trisopterus minutus capelanus</i> (Lacepède, 1800)		x y	x y	y		60	325	8.03	4
* <i>Molva dipterygia macrophthalma</i> (Rafinesque, 1810)			x	x y	x y	160	700	20.21	3

Table II (continued)

Family - Species	Bathymetric stratum (m)					Depth (m)		F (%)	A.c.
	0-50	50-100	100-200	200-450	450-700	min	max		
* <i>Phycis phycis</i> (Linnaeus, 1766)			x y	y		120	300	1.30	-
* <i>Phycis blennoides</i> (Brünnich, 1768)		x y	x y	x y	x y	62	700	51.81	4
<i>Antonogadus megalokynodon</i> (Kolombatovic, 1894)	y	x y	x y	x y	x y	40	600	8.55	3
ERETMOPHORIDAE									
<i>Gadella maraldi</i> (Risso, 1810)				x y	x y	300	625	3.63	3
<i>Mora moro</i> (Risso, 1810)					x		685	0.26	1
TRACHICHTHYIDAE									
<i>Hoplostethus mediterraneus</i> Cuvier, 1829				x y	x y	250	700	12.95	4
ZEIDAE									
* <i>Zeus faber</i> Linnaeus, 1758	x y	x y	x y	x y		18	300	11.14	2
CAPROIDAE									
<i>Capros aper</i> (Linnaeus, 1758)	y	x y	x y	x y	x	40	550	12.44	4
SERRANIDAE									
* <i>Serranus cabrilla</i> (Linnaeus, 1758)	x y	x y	x			11	120	14.51	3
<i>Serranus hepatus</i> (Linnaeus, 1758)	x y	x y	x y	x		15	275	16.84	3
* <i>Serranus scriba</i> (Linnaeus, 1758)	x y	x	x y			15	175	2.85	-
* <i>Epinephelus aeneus</i> (E.G. Saint-Hilaire, 1817)	x y					25	50	0.52	-
* <i>Polyprion americanus</i> (Schneider, 1801)	x y		x			20	175	0.78	-
APOGONIDAE									
<i>Epigonus telescopus</i> (Risso, 1810)				x y	x	300	575	0.78	1
<i>Epigonus denticulatus</i> Dieuzeide, 1950				x	x y	275	690	2.33	3
CEPOLIDAE									
* <i>Cepola macrophthalmia</i> (Linnaeus, 1758)	x y	x y	x y	y		20	300	16.06	4
CARANGIDAE									
* <i>Caranx rhonchus</i> E.G. Saint-Hilaire, 1817	x		x	x		30	320	1.81	-
* <i>Trachurus trachurus</i> (Linnaeus, 1758)	x y	x y	x y	x y	x	12	470	30.31	5
* <i>Trachurus mediterraneus mediterraneus</i> (Steindachner, 1868)	x y	x y	x y	y		18	300	4.15	3
* <i>Trachurus picturatus</i> (T.E. Bowdich, 1825)		x				60	75	0.52	-
MULLIDAE									
* <i>Mullus barbatus</i> Linnaeus, 1758	x y	x y	x y	x y		11	425	36.27	5
* <i>Mullus surmuletus</i> Linnaeus, 1758	x y	x y	x y	x y	x	11	575	26.17	4
SPARIDAE									
* <i>Sparus aurata</i> Linnaeus, 1758	x						18	0.78	-
* <i>Sparus pagrus</i> (Linnaeus, 1758)	x y	y				40	75	1.04	-
* <i>Boops boops</i> (Linnaeus, 1758)	x y	x y	x y	x y		12	350	24.87	3
* <i>Dentex dentex</i> (Linnaeus, 1758)	y	x				15	85	0.78	-
* <i>Diplodus annularis</i> (Linnaeus, 1758)	x y	x y				11	85	7.77	3
* <i>Diplodus sargus</i> (Linnaeus, 1758)	x y					17	24	0.78	-
* <i>Diplodus vulgaris</i> (E.G. Saint-Hilaire, 1817)	x y					12	40	0.78	-
* <i>Lithognathus mormyrus</i> (Linnaeus, 1758)	x y	y				11	60	4.15	2
* <i>Oblada melanura</i> (Linnaeus, 1758)	x						40	0.26	-
* <i>Pagellus erythrinus</i> (Linnaeus, 1758)	x y	x y	x	x y		12	310	25.39	4
* <i>Pagellus acarne</i> (Risso, 1826)	x y	x y	x y	x y		17	340	16.06	3
* <i>Pagellus bogaraveo</i> (Brünnich, 1768)	x y	y	x y	x y	x y	18	650	11.40	2
* <i>Puntazzo puntazzo</i> (Gmelin, 1789)	y						11	0.26	-
* <i>Sarpa salpa</i> (Linnaeus, 1758)	y						11	0.26	-
* <i>Spondylisoma cantharus</i> (Linnaeus, 1758)	y						11	0.26	-
CENTRACANTHIDAE									
* <i>Centracanthus cirrus</i> Rafinesque, 1810		x	x			55	130	0.52	-
* <i>Spicara maena maena</i> (Linnaeus, 1758)	x y	x		x		20	310	1.81	-
* <i>Spicara maena flexuosa</i> Rafinesque, 1810	x y	x y	x y			15	175	12.18	4
* <i>Spicara smaris</i> (Linnaeus, 1758)	x y	x y	x y	x		11	300	23.06	3
LABRIDAE									
* <i>Labrus bimaculatus</i> Linnaeus, 1758	x	x				22	95	0.52	-
* <i>Coris julis</i> (Linnaeus, 1758)	x y	x				11	60	2.85	1
<i>Symphodus rostratus</i> (Bloch, 1797)	y						13	0.26	-
<i>Symphodus cinereus</i> (Bonnaterre, 1788)	x y						15	1.04	1
<i>Symphodus mediterraneus</i> (Linnaeus, 1758)	x						20	0.26	-
* <i>Xyrichtys novacula</i> (Linnaeus, 1758)	x y					11	40	8.81	1
TRACHINIDAE									
* <i>Trachinus draco</i> Linnaeus, 1758	x y	x y	x y	x		12	375	18.65	2

Table II (continued 2)

Family - Species	Bathymetric stratum (m)					Depth (m)		F (%)	A.c.
	0-50	50-100	100-200	200-450	450-700	min	max		
* <i>Trachinus radiatus</i> Cuvier, 1829	x y	x y		x		16	300	2.07	-
URANOSCOPIDAE									
* <i>Uranoscopus scaber</i> Linnaeus, 1758	x y	x y	x y	x y		11	425	20.47	2
TRICHIURIDAE									
* <i>Lepidopus caudatus</i> (Euphrasen, 1788)		x	x y	x y	x y	85	625	13.47	4
SCOMBRIDAE									
* <i>Scomber scombrus</i> Linnaeus, 1758	x	x y	x y			20	138	3.89	2
GOBIIDAE									
* <i>Gobius niger</i> Linnaeus, 1758	x y	x y	x y			13	120	8.81	2
* <i>Deltentosteus quadrimaculatus</i> (Valenciennes, 1837)	x	x y	x			20	190	3.37	3
* <i>Lesueurigobius suerii</i> (Risso, 1810)	y	y	y	y		15	280	1.04	2
* <i>Lesueurigobius friesii</i> (Malm, 1874)	x	x	x	x y		20	360	2.59	2
* <i>Zosterisessor ophiocephalus</i> (Pallas, 1811)	x y	y				20	90	0.78	-
CALLIONYMIDAE									
* <i>Callionymus maculatus</i> Rafinesque, 1810	x y	x y	x y	y	x	15	594	5.96	3
* <i>Callionymus phaeton</i> Günther, 1861	x	y		x y	x	30	575	4.15	1
* <i>Callionymus pusillus</i> Delaroche, 1809	x					20		0.26	-
* <i>Callionymus risso</i> Le Sueur, 1814	x			x		35	370	0.78	-
BLENNIIDAE									
* <i>Blennius ocellaris</i> Linnaeus, 1758	x y	x y				17	100	4.92	2
BROTULIDAE									
* <i>Benthocometes robustus</i> (Goode & Bean, 1886)					x y	479	575	0.78	-
OPHIDIIDAE									
* <i>Ophidion barbatum</i> Linnaeus, 1758	x	x	x y	x y	x	25	625	6.48	2
CARAPIDAE									
* <i>Carapus acus</i> (Brünnich, 1768)				y		300		0.26	-
* <i>Echiodon dentatus</i> (Cuvier, 1829)				y		413	445	0.78	-
CENTROLOPHIDAE									
* <i>Centrolophus niger</i> (Gmelin, 1789)				x y	x	400	510	0.78	1
SPHYRAENIDAE									
* <i>Sphyræna sphyraena</i> (Linnaeus, 1758)	x y					25	40	0.78	-
MUGILIDAE									
* <i>Mugil cephalus</i> Linnaeus, 1758	y					15		0.26	-
* <i>Liza aurata</i> (Risso, 1810)	x					16		0.26	-
SCORPAENIDAE									
* <i>Scorpaena porcus</i> Linnaeus, 1758	x y	x y	x			17	125	5.44	1
* <i>Scorpaena elongata</i> Cadenat, 1943			y	x		175	275	0.52	-
* <i>Scorpaena loppei</i> Cadenat, 1943	x					30		0.26	-
* <i>Scorpaena notata</i> Rafinesque, 1810	x	x y	y	x		16	320	4.66	2
* <i>Scorpaena scrofa</i> Linnaeus, 1758	x y	x	x y	x y		11	400	3.89	1
* <i>Helicolenus dactylopterus dactylopterus</i> (Delaroche, 1809)		y	x y	x y	x y	100	690	40.67	4
TRIGLIDAE									
* <i>Trigla lyra</i> Linnaeus, 1758	x y	x y	x y	x y		18	400	17.36	3
* <i>Trigla lucerna</i> Linnaeus, 1758	x y	x y	x y	y		15	400	23.32	3
* <i>Aspitrigla cuculus</i> (Linnaeus, 1758)	x	x y	x y	x		17	275	6.22	2
* <i>Eutrigla gurnardus</i> (Linnaeus, 1758)	x	x y	x y	x	x	20	500	4.92	2
* <i>Lepidotrigla cavillone</i> (Lacepède, 1801)	x y	x y	x y	x y		20	430	11.92	3
* <i>Lepidotrigla dieuzeidei</i> Audouin, in Blanc & Hureau, 1973			y			160		0.26	-
* <i>Trigloporus lastoviza</i> (Brünnich, 1768)	x y	x y	x	x y		20	325	11.66	3
PERISTEDIIDAE									
* <i>Peristedion cataphractum</i> (Linnaeus, 1758)			x	x y	x	175	550	3.37	3
CEPHALACANTHIDAE									
* <i>Cephalacanthus volitans</i> (Linnaeus, 1758)	x y					15	20	2.07	2
CITHARIDAE									
* <i>Citharus macrolepidotus</i> (Bloch, 1787)	x	x	x	x		30	300	1.30	2
SCOPHTHALMIDAE									
* <i>Lepidorhombus whiffiagonis</i> (Walbaum, 1792)		x		x y		80	429	1.81	1
* <i>Lepidorhombus bosci</i> (Risso, 1810)	x y	x y	x y	x y	x y	12	650	45.08	3
* <i>Psetta maxima</i> (Linnaeus, 1758)	x y					11	24	0.52	-

Table II (continued 3)

Family - Species	Bathymetric stratum (m)					Depth (m)		F (%)	A.c.
	0-50	50-100	100-200	200-450	450-700	min	max		
BOTHIDAE									
* <i>Botus podas podas</i> (Delaroche, 1809)	x y	y			x	11	525	5.96	4
* <i>Arnoglossus laterna</i> (Walbaum, 1792)	x y	x y	x y	x y	x	15	550	20.73	4
* <i>Arnoglossus rueppelli</i> (Cocco, 1844)			x	x y		175	300	1.04	3
* <i>Arnoglossus thori</i> Kyle, 1913	y					15		0.26	-
SOLEIDAE									
* <i>Solea vulgaris vulgaris</i> Quensel, 1806	x y	y	x			16	130	3.89	1
<i>Solea kleini</i> Bonaparte, 1833	y					16	20	1.04	-
<i>Buglossidium luteum</i> (Risso, 1810)	x y	y				16	55	1.55	1
<i>Microchirus variegatus</i> (Donovan, 1808)	x	y				25	97	1.29	-
<i>Microchirus ocellatus</i> (Linnaeus, 1758)	x y	y				16	50	1.81	1
<i>Monochirus hispidus</i> Rafinesque, 1814	x					20	30	0.52	1
CYNOGLOSSIDAE									
<i>Symphurus nigrescens</i> Rafinesque, 1810	x y	x y	x y	x y	x	20	550	8.55	2
BALISTIDAE									
<i>Balistes carolinensis</i> Gmelin, 1789	y					45		0.26	-
TETRAODONTIDAE									
<i>Sphoeroides pachygaster</i> (Muller & Troschel, 1848)			x	x		130	400	0.52	-
LOPHIIDAE									
* <i>Lophius piscatorius</i> Linnaeus, 1758	x y	x y	x y	x y	x y	17	575	29.53	3
* <i>Lophius budegassa</i> Spinola, 1807	x y	x y	x y	x y	x y	17	627	35.49	3

The macrourid fish (*Hymenocephalus italicus*, *Nezumia sclerorhynchus* and *Caelorinchus coelorhynchus*), *Chlorophthalmus agassizi*, *Hoplostethus mediterraneus* and *Lepidopus caudatus* showed high abundance. These species were found with percentage frequencies between 10.10 and 14.77.

Some other species, such as *Uranoscopus scaber*, since they were fished across a wide bathymetric gradient in both seasons but with one or few specimens, presented noteworthy frequency indexes and low abundance.

Intermediate frequency and abundance was shown for other species, such as *Molva dipterygia macrophthalma*, *Spicara smaris* and *Trigla lucerna*.

DISCUSSION AND CONCLUSIONS

The 159 species found through this research represent 27.5% of the 579 fish species quoted by Tortonese (1987) for the Mediterranean Sea. The ichthyofauna of the study area, as observed for the eastern Ionian Sea (Kaspiris, 1976; Papaconstantinou, 1985, 1986), has an Atlanto-Mediterranean character: 136 species belong to this category, 3 are cosmopolitan, 8 world wide and 12 endemic of Mediterranean.

Compared to the previous lists concerning the ichthyofauna of the north-western Ionian Sea (Gallotti, 1973; Pastore, 1976; Parenzan 1983) new records (1 selachian and 4 teleosts) have been registered.

The records of *Sphoeroides pachygaster* would confirm the progressive settlement and adaptation of this subtropical species in the Mediterranean waters, even if Relini and Orsi Relini (1995) consider that the species has been present in this basin for a long time. The recent finding of a specimen at 400 m indicates a wider depth distribution of the species than that reported in the literature (Blache *et al.*, 1970; Hureau and Monod, 1978; Calvario *et al.*, 1980; Vacchi and Cau, 1986; Fiorentino and Zamboni, 1990; Tursi *et al.*, 1992).

In the list of fish reported in this paper all those species that live exclusively on rock bottoms, either coastal or offshore, and the typically pelagic species (for example bluefin tuna and swordfish) were absent. However, some semi-demersal or pelagic species were considered in the list because, in addition to being abundant, such as *Micromesistius poutassou*, *Trachurus trachurus* and *Lepidopus caudatus*, they were probably caught in the water column during the hauling of the net on board. So, for example, *Chauliodus sloani*, *Stomias boa*, *Argyroleleus hemigymnus* were recorded rather occasionally because they are bathypelagic species living in the water column. For them and many other pelagic species the knowledge on their distribution and abundance in the area and on their bio-ecological aspects, is still rather limited.

The bathymetric distribution of the species caught on trawlable bottoms generally confirm, what is reported by the literature. However, the species *Conger conger*, *Echelus myrus*, *Merlangius merlangus euxinus*, the species of genus *Spicara* and *Trachinus*, *Callionymus risso*, *Ophidion barbatum*, *Eutrigla gurnardus*, *Trigloporus lastoviza* and *Arnoglossus laterna* were recorded also at greater depths compared to those indicated by Whitehead *et al.* (1984-86) and Bauchot (1987). Moreover, compared respect to that reported by these authors the species *Notacanthus bonapartei*, *Nezumia sclerorhynchus* and *Antonogadus megalokynodon* exhibited a wider depth distribution towards shallower water. In our opinion, the narrow continental shelf of the Ionian Sea and the presence of canyons and upwelling current along the Calabrian coasts can favour the ascent of typical bathyal species, as recently shown for bathyal shrimps *Aristeus antennatus* and *Aristaeomorpha foliacea* which were found in shallow waters (Matarrese *et al.*, 1995).

Some species, such as *Citharus macrolepidotus* or *Lesueurigobius suerii*, were recorded only in spring and in autumn respectively, but with such a low frequency and abundance that it is not possible to draw any conclusion about seasonal differences in their bathymetric distribution. The different distribution (shallower or deeper) observed in spring for some species and in autumn for others across the whole depth range can be considered as merely casual. In fact, the presence of *Helicolenus dactylopterus dactylopterus* in shallow water during autumn was in disagreement with the generally more coastal distribution during spring in the area when the recruitment of the species occur (D'Onghia *et al.*, 1992, in press).

Galeus melastomus is the most common and abundant selachian on the trawled bottoms. Information on its distribution and biology in the area are reported by Tursi *et al.* (1990, 1993a).

Apart from the abundance of the most common species of commercial interest, such as *Merluccius merluccius*, *Mullus barbatus*, *Micromesistius poutassou* and *Trachurus trachurus*, the north-western Ionian Sea, has long been characterized, on the bathyal grounds, by the abundance of macrourid fish (*Hymenocephalus italicus*, *Nezumia sclerorhynchus* and *Caelorinchus coelorhynchus*), *Chlorophthalmus agassizi* and *Hoplostethus mediterraneus* (Brunelli and Bini, 1934).

The wide range of frequencies and abundances, observed for the various species is summarized in table III. The majority of both selachians and teleosts species, not found in the last four surveys were generally those with the lowest frequency indexes.

In the neighbouring southern Adriatic Sea 118 species of teleosts were caught using the same research methods (Bello and Rizzi, 1988). A total of 100 of them have also been recorded in the north-western Ionian Sea, thus proving a high affinity between the demersal fish fauna of these two Mediterranean areas. The species found in the north-

Table III. - Frequency and abundance observed for the ichthyofauna in the north-western Ionian Sea.

Frequency index (%)	Abundance category	Example of species
Very high frequency >60	Very abundant	<i>Merluccius merluccius</i>
High frequency 40-60	Very abundant	<i>Micromesistius poutassou</i>
	Abundant	<i>Phycis blennoides</i> <i>Helicolenus dactylopterus dactylopterus</i>
	Not rare	<i>Lepidorhombus boscii</i> <i>Conger conger</i>
Medium frequency 20-40	Very abundant	<i>Mullus barbatus</i> <i>Trachurus trachurus</i>
	Abundant	<i>Galeus melastomus</i> <i>Mullus surmuletus</i> <i>Pagellus erythrinus</i> <i>Amoglossus laterna</i>
	Not rare	<i>Molva dipterygia macrophthalma</i> <i>Spicara smaris</i> <i>Trigla lucerna</i> <i>Lophius piscatorius</i> <i>Lophius budegassa</i>
	Rare	<i>Uranoscopus scaber</i>
Low frequency 5-20	Abundant	<i>Argentina sphyraena</i> <i>Chlorophthalmus agassizi</i> Macrourid fish <i>Gadiculus argenteus argenteus</i> <i>Hoplostethus mediterraneus</i> <i>Capros aper</i> <i>Cepola macrophthalma</i> <i>Spicara maena flexuosa</i> <i>Lepidopus caudatus</i>
	Not rare	<i>Scyliorhinus canicula</i> <i>Etmopterus spinax</i> <i>Chimaera monstrosa</i> <i>Serranus hepatus</i> <i>Pagellus acarne</i> <i>Trigla lyra</i> <i>Lepidotrigla cavillone</i>
	Rare	<i>Zeus faber</i> <i>Pagellus bogaraveo</i> <i>Trachinus draco</i> <i>Aspitrigla cuculus</i>
Very low frequency <5	Abundant	<i>Glossanodon leiglossus</i>
	Not rare	<i>Lampanyctus crocodilus</i> <i>Trachyrhynchus trachyrhynchus</i> <i>Epigonus denticulatus</i> <i>Trachurus mediterraneus mediterraneus</i>
	Rare	<i>Scymnorhinus licha</i> <i>Notacanthus bonapartei</i> <i>Scorpaena notata</i> <i>Eutrigla gurnardus</i> <i>Citharus macrolepidotus</i>
	Very rare	<i>Mustelus mustelus</i> <i>Centrophorus granulosus</i> <i>Raja miraletus</i> <i>Raja asterias</i> <i>Raja circularis</i> <i>Nemichthys scolopaceus</i> <i>Echelus myrus</i> <i>Mora moro</i> <i>Epigonus telescopus</i> <i>Callionymus phaeton</i> <i>Centrolophus niger</i> <i>Lepidorhombus whiffiagonis</i>

western Ionian Sea not fished in the southern Adriatic and *vice versa* are however recognized as present in the two basins.

The majority of the common species in both districts exhibited a similar depth distribution while some others, such as *Notacanthus bonapartei*, *Nezumia sclerorhynchus*, *Capros aper*, *Pagellus erythrinus*, *Trachinus draco*, *Uranoscopus scaber*, *Lepidopus caudatus*, *Callionymus risso*, *C. phaeon* and *Ophidion barbatum* were found across a wider bathymetric range in the north-western Ionian Sea than in the south-eastern Adriatic. The most abundant species were the same in the both areas.

The scarcity of the batoids species was revealed in the course of research period in the north-western Ionian Sea. In addition to the solitary habit of these fishes, the very low frequency in the catches could be correlated to the efficiency of the gear used. However, as recently observed in the southern Adriatic Sea (Ungaro *et al.*, in press), a reduction in biodiversity and abundance could be due to the overexploitation of the spawning stocks since selachians have low reproduction capacity. The abundance of *Galeus melastomus* and other bathyal selachians can be maintained in pristine condition because of the wider distribution area of these species, also in terms of depth range, than that reached by the fishing gear.

Ungaro *et al.* (in press), using the same methodology, have collected 15 selachians species in the southern Adriatic Sea among which 10 were in common with those of the north-western Ionian Sea. These species exhibited similar depth distribution and abundance in the two areas.

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